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(71) Applicant *(for all designated States except US)*: **TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)** [SE/SE]; S-126 25 Stockholm (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **SVANBRO, Krister** [SE/SE]; Skogsbrynet 11, S-975 75 Luleå (SE). **LINDAHL, Göthe** [SE/SE]; Brunnsvägen 15, S-905 94 Umeå (SE). **JONSSON, Erik** [SE/SE]; Skolgatan 136A, S-903 32 Umeå (SE). **ROSENQVIST, Erik** [SE/SE]; Skogsbrynet 32, S-903 37 Umeå (SE). **WIKSTRAND, Greger** [SE/SE]; Rågången 1A, S-903 37 Umeå (SE).

(74) Agent: **BOESTAD, Karin**; Ericsson AB, Patent Unit Core Networks Kista, S-164 80 Stockholm (SE).

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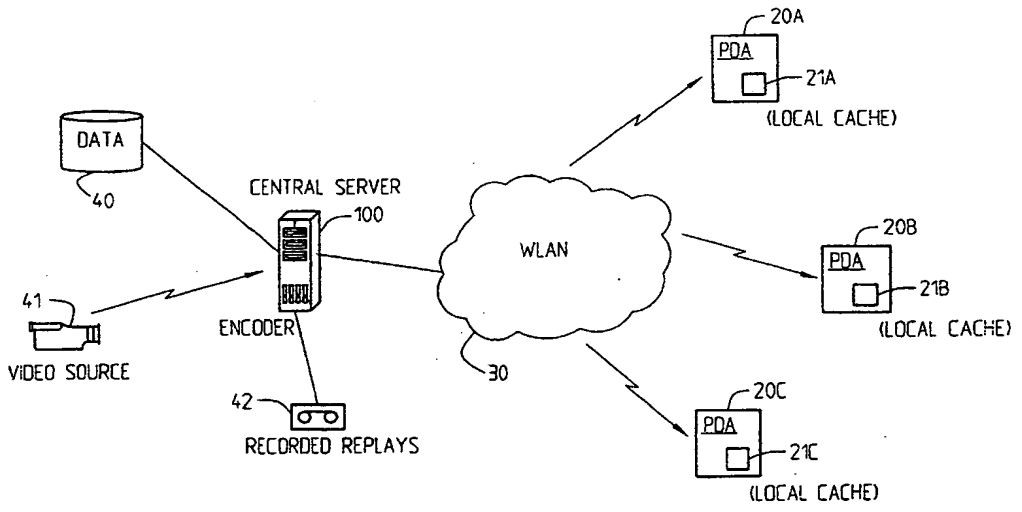
(54) Title: A SYSTEM AND A METHOD RELATING TO COMMUNICATION OF DATA



(57) Abstract: The present inventions relates to a system for communication of data information, e.g. multimedia content, over a wireless network connecting a plurality of end user stations and supporting broadcast/multicast transmission.It comprises central server means with at least one central cache arrangement for storing at least selected parts of data information relevant for at least a segment of the wireless network, transmission scheduling means for transmission scheduling, central cache arrangement control means for, by using scheduling information, controlling a central cache arrangement push engine for multicast/broadcast pushing of information to end user stations within said at least one segment of the wireless network. The end user stations comprise or are associated with proprietary, local push content caching means for holding the pushed data information, and, upon request by the respective end user, selected data information may be presented to the end user in a customized manner via a user client from said local caching means.

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A SYSTEM AND A METHOD RELATING TO COMMUNICATION OF DATA

FIELD OF THE INVENTION

The present invention relates to a system for communication of data, e.g. multimedia content, over a wireless network connecting a plurality of end user stations, which system supports broadcast/multicast transmission. The invention also relates to a central server in such a system and to an end user station in such a system. The inventive concept also covers a method for communication of data, such as multimedia content, over a wireless network connecting a plurality of end user stations and supporting broadcast/multicast transmission.

STATE OF THE ART

In a wireless network the bandwidth that is available for each respective end user station or, for each device, is very limited. Therefore it is in principle impossible to be able to serve a large number of simultaneous requests for larger amounts of data information, such as for example multimedia content. In for example Hiperlan/2, 250 users share a bandwidth of 25 Mbps at the IP layer (layer 3). This gives 100 kbps per end user. In IEEE 802.11b, according to which there may be maximum 1020 users in a network, a typical implementation will be able to handle 63 users. Based on the 1020 users of the standard, there will be 6 kbps available for each user. This gives about 95 kbps per end user. It is moreover realistic to assume that for example only half of that capacity actually can be used at any one time due to for example radio transmission problems, buffer overruns etc. This will result in a situation in which for example only 50 kbps is available for each user. If for example some kind of multimedia content, such as video clips, is to be transferred, in order to assure an acceptable quality, it requires encoding at 128-500 kbps. If only a few clients request to be served at the same time, or at once,

or for example if the clips are short, it may be possible to ignore the problems, but as soon as a larger number of end users simultaneously request to be served, the problems will indeed be severe. Different suggestions to the problems have been given. One suggestion is to vary the bandwidth and for example by all means transmit at 50 kbps. This can be done by encoding the stream using multilayer encoding so that the quality goes down automatically when packets are dropped for example due to congestion, interference or bit errors. It is also possible to negotiate the bandwidth requirements between the client and the server. As far as video clips are concerned, it could also be possible to vary the dimensions of the clip in order to save bandwidth. This would reduce the time a user would have to wait. By for example reducing the display size of an end user station to one tenth of its maximum size, the number of simultaneous accesses could be considerably increased. Another suggestion has been to change the clip length etc.

Still another suggestion has been to force user clients to co-operate. When a user client requests a clip from the server, it has to wait x seconds, such that the server can see if any other user clients in the same segment of the wireless network do want the same clip. However, in the worst case the user might have to wait x seconds for nothing. To summarize, all these approaches will result in a decreased quality and increased delays when there is congestion, or when several users simultaneously request access to the same content. Thus none of these proposals function satisfactorily.

An example when such problems, as initially referred to, occur are for example at an arena having thousands of spectators. Many of the spectators will have for example Personal Digital Assistants (PDA) or similar devices that can be connected to an IP network.

However, if as many spectators as possible should be reached, i.e. if it should be possible to provide them with individual audio/video information, bandwidth availability would be a serious problem. In order to offer reruns and video on demand today to a PDA on an IP network, the unicast streaming video method is used. In that manner several users can be served, but it is not sufficient for large number of end user stations in so called hotspots in which a huge number of end users are gathered.

US-A-0 595 6716 describes a local storage and retrieval unit (SRU) that temporarily stores video clips downloaded by several extended SRUs to display the video clip in a multimedia terminal. It is however not attractive for practical reasons to use a special storing device in a hot spot since there may be a large amount of people in a crowd. US-A-5 854 887 discloses a system in which clips will be made available, not based on current network load, but only to a fixed figure. That system does also not function satisfactorily when there is a large number of simultaneous requesters for multimedia data, that is predictable.

Thus, today, there is no satisfactorily functioning system or method known which is able to handle the problems initially referred to.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a system through which it gets possible to provide end user stations with access to data information over a wireless network even if there is a large, or even huge, number of end user stations within a limited area requesting access at more or less the same time. It is also an object of the invention to be able to serve as many end user stations as possible, if they for example are gathered in a so called hotspot, by giving them quick access to the requested

data information. Particularly it is an object to enable access for end user stations to individually selected data information at substantially individually selected times from a multimedia presentation. Particularly it is an object of the invention to, also at so called hotspots, be able to offer customized access to data information, such as multimedia content, live or in the form of clips. Particularly it is an object to provide also a large number of end user stations with customized access to live content, e.g. video, video clips, audio, web pages, relevant information in general or any files or applications in an easy and flexible manner. Particularly it is an object of the present invention to provide a system which is easy to implement and which is able to provide the end user with freedom and flexibility as far as (multimedia) data requests are concerned. It is also an object of the present invention to be able to provide end user stations with wireless access to requested or appropriate data depending on where end user is located in an easy and fast manner. Particularly it is an object of the invention to provide a system which allows end user access in a customized manner to different kinds of data information, multimedia content, or files etc. in a very fast manner and while still maintaining a high quality, particularly giving the end user the option to rerun or replay, i.e. retrieve, the desired data information whenever he wants to, and as many times as he wants.

It is also an object of the present invention to provide an end user station through which one or more of the above mentioned objects can be achieved, as well as a central server means through which the end user stations can be provided with easy and flexible, customized representation as referred to above. Particularly it is an object to provide end user stations which are easy to fabricate and easy to use. Particularly it is an object to provide end user stations which, in combination with a

central server of a system as referred to above, allows an end user to flexibly select which data information he wants to be presented with and when he wants to be presented with the data information, how many times etc., particularly irrespectively of there being a large number of simultaneously requesting other end user stations. It is also particularly an object to provide an end user station through which an end user can be provided with relevant data information depending on where in the network the end user station is located and to allow the station to obtain the relevant information at the relevant time and at the relevant place.

It is also an object of the invention to provide a central server means which is able to provide end user stations with the above mentioned facilities. Still further it is an object of the invention to provide a method through which one or more of the above mentioned objects can be achieved.

Therefore a system as initially referred to is provided, which comprises a central server means with at least one central cache arrangement for storing at least selected parts of data information relevant for at least a segment of the wireless network. The central server means also comprises transmission scheduling means for transmission scheduling, a central cache arrangement control means for, by using information from the transmission scheduling means, controlling a central cache arrangement push engine for multicast/broadcast pushing of information to end user stations within the at least one segment of the wireless network. The end user stations comprise, or are associated with, each a proprietary or local push content caching means for holding the pushed data information. Upon request by the respective end user, selected data information will be presented to the end user in a customized manner via the end user station

user client, by retrieval from said local, proprietary caching means.

In a particular implementation a segment of a network corresponds to a local area or part of the wireless network. Particularly a segment corresponds to a local part or area of the network with at least a temporarily large or huge amount of connected end user stations, forming a so called hot spot, e.g. a sports arena, a public place for spectacular events or any other location with a large number of simultaneously connected end user stations. In a particular implementation partly overlapping segments are implemented, to which particularly somewhat or slightly differing data information is pushed via multicast/broadcast. Even more particularly information can be exchanged between end user stations of said partly overlapping segments, in case an end user station is connected to a segment in which the desired information is not pushed to that end user station but to the other end user station in the other of the partly overlapping segments.

Preferably the pushed data information content is segment dependent, i.e. which data information that is pushed, depends on which is the segment, i.e. it is location dependent or interest dependent in overlapping segments. In one implementation the same content can be pushed to more than one segment of the wireless network. Particularly location detecting means are used, or e.g. a GPS (Global Positioning System), MPS (Mobile Positioning System), direct cell addressing etc. such that when an end user enters an area/a segment, the relevant information will automatically be pushed to its local push content storing means (the proprietary local cache).

In one embodiment the end user station client is allocated a segment at connecting to the system and entering an area

corresponding to the segment, or at establishment of an end user usage pattern, according to another alternative.

The pushed data information may comprise multimedia information, files, web pages such as for example HTML, GIF, JPEG or any other file, video clips, live video, audio.

In a particular implementation one multicast/broadcast session is used to transmit several multimedia content/file/video clips, or web pages. In an alternative implementation a new multicast/broadcast session is opened for each multimedia content, e.g. (video) clip or web page or file transmission. Still further, a single multicast/broadcast channel can be used for each parallell distribution channel. Alternatively several multicast/broadcast sessions are used for each parallel distribution channel.

In a preferred implementation the central cache arrangement push engine is responsible for pushing data information content to the end user stations of more than one segment. The central cache arrangement push engine may also comprise several push engines, one for each segment. There may also be one central cache arrangement control means (and push engine) for each segment. Alternatively, one push engine can be responsible for more than one segment or one control means can be responsible for more than one segment.

Particularly the central cache arrangement comprises a number of subordinate cache control engines, one for each segment, and a superior, master, cache control engine controlling said subordinate cache control engines. Preferably said superior cache control engine is also responsible for coordinating transmissions and for handling end user station segment roaming.

In a preferred implementation the content information of the transmission scheduling means is communicated to the end user stations within the concerned segment allowing the end user to select data information, e.g. live content or content clips, for requests. The content information may for example be presented as lists or in any other appropriate manner to the end user stations. Lists of content are transmitted indicating the content that forms an entity.

Particularly the scheduling means uses an algorithm based on information about for example estimated/predicted content and end user demand, particularly minimizing the delay between end user request and actual presentation to the end user. Feedback from a number of end user stations may also be used.

In a particular implementation, for end user requests for live video streaming, the end user station client may connect separately to the live multicast/broadcast stream without having the content passing the local, proprietary cache.

Particularly retransmissions from the central server arrangement can be requested, and a time limit may be given, such that if transmission actually is due within the given time interval, no retransmission is requested from the cache engine, otherwise retransmission is requested.

The wireless network is preferably IP-based, but could also be used in WLAN IEEE 802.11a & b, HIPERLAN/2, 3 & 4, GSM, GPRS, EDGE, PDC, CDMA, WCDMA, CDMA2000, hybrid networks with DVB and a back-Channel, etc.

The invention also provides an end user station for use in a wireless network supporting communication of data information, e.g. multimedia content, which comprises or is associated with a proprietary, local push content caching means for holding data information pushed via multicast or broadcast transmission to the end user station by a central server means controlling pushing of data information to at least a segment of the wireless network in which the end user station is connected/located. Upon request selected information can be fetched from the local push content caching means to the client of the end user station in a customized manner, e.g. when the end user wants to use or access it, what the end user wants to be presented with, when the end user wants to be presented with the information and for example also how many times the end user station wants to be provided with the requested information.

In a particular implementation the end user station comprises means for receiving information about information pushed to, or to be pushed to, the end user station, e.g. a list or a schedule, such that the end user can base requests on said information to select the desired content to be presented at a relevant time or location. Even more particularly the proprietary, local push content cache comprises a proxy. The data information may comprise multimedia content such as live content, e.g. video, content, e.g. video clips, data information clips in general, web pages, audio, files such as HTML, GIF, JPEG or similar. In a particular implementation the end user station comprises a personal digital assistant (PDA), but it may also be other devices, particularly wireless and mobile, although the concept of course also covers non-mobile end user stations.

The invention also suggests a central server means in a wireless network which comprises at least one central cache arrangement for

storing at least selected parts of data information relevant for at least a segment of the wireless network. The central server means further comprises transmission scheduling means, central cache arrangement control means for, by using information from the scheduling means, controlling a central cache arrangement push engine for automatically, via multicast/broadcast pushing selected information to wireless stations connected to the said at least one segment of the wireless network.

Particularly content information relating to the selected data information, e.g. multimedia content, live or clips, files etc. is provided (i.e. pushed) to the end user stations of the segment. Particularly the central cache arrangement comprises a number of cache control engines, one for each of a number of segments, and a superior, master, cache control engine controlling said subordinate cache control engines and preferably coordinating transmissions. Advantageously the central server means comprises one push engine for each of a number of segments, particularly one for each segment.

It is an advantage of the invention that it gets possible to send individually selected multimedia content on demand, e.g. files or content, or clips or live, or moving pictures to a large number of end user stations without having to rely on bandwidth consuming unicast on IP networks. As an example it will be very advantageous as far as reruns and multimedia content on demand applications on IP networks are concerned. It is also an advantage that relevant multimedia content can be presented to end user stations depending particularly on location, since the relevant multimedia content is pushed to the users which then can request it, using information about content, the way, the time etc. independently of whether a large number of other users substantially simultaneously request

substantially the same multimedia content but for example selecting different parts of it etc, in an unsynchronized manner.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will in the following be further described in a non-limiting manner, and with reference to the accompanying drawings, in which:

Fig. 1A is a schematical overview of a system according to one implementation of the invention,

Fig. 1B is a very schematical overview of a system, indicating three different segments,

Fig. 2 is a block diagram of the central server means of the system,

Fig. 3 is a block diagram of an end user station (client side) of the system according to one embodiment,

Fig. 4 is a block diagram on a functional level for one, simplified, embodiment of the invention,

Fig. 5 is a block diagram on a functional level of another embodiment of the invention,

Fig. 6 is a flow diagram describing one example on a scheduling procedure according to one embodiment,

Fig. 7 is a flow diagram describing the flow on the transmitting (server) side according to one embodiment,

Fig. 8 is a flow diagram describing the flow at the receiving (end user station or client) side of the system,

Fig. 9 is a flow diagram describing the flow of the local proxy cache handler in a particular embodiment, and

Fig. 10 is a block diagram which schematically illustrates implementation of the inventive concept to WWAN (Wireless Wide Area Network), e.g. GSM/GPRS and UMTS.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1A shows a very general overview of a system according to the invention indicating one way that it can be implemented. The server means 100 here comprises encoding means and a server to which, in this particular embodiment, multimedia content as data 40, live video or video clips are provided from a video source 41, and in which recorded replays 42 are stored. In more general terms, when referring to video, clip etc. it should be clear that this is just as applicable to any other files such as HTML, GIF, JPEG etc., any content in form of clips or live, but for reasons of simplicity, in this implementation it is supposed that a video source or text, pictures etc. is/are captured, and a producer, which may be manual or automatic, picks out sequences supposed to be of interest. The producer also encodes and stores the relevant sequences on the server. In one implementation the producer tags the pieces of information or clips, files etc. with information like title or comments around the event. Any information like text, pictures, music etc. is treated in one and the same way, and in this document the data is denoted Cache Data Unit (CDU). The system automatically recognizes new CDUs and transmits them to a multicast/broadcast group. This transmission method is determined by the coder/decoder modules of the server means, 100. Via multicast (or broadcast) pushing the information or multimedia

content (CDUs) are pushed to the respective end user stations 20A, 20B, 20C, which here are PDAs, automatically and before the content is requested by the end users. (A piece of multimedia content may be requested by some users, by others not, at different times, in various repeated manners.) The CDUs can be distributed to several multicast/broadcast groups, i.e. to one or more segments.

In Fig. 1A it is supposed that PDA 20A, 20B, 20C belong to one and the same segment and therefore receive the same data information from the central server means 100.

Fig. 1B is a figure similar to that of Fig. 1A, but wherein three different segments are illustrated. The same content x is pushed by the central server means 100A to segment 1 and 2 with a slight modification x' and an entirely different content y is provided to segment 3. If for example the Bluetooth concept is implemented, end user stations of segment 1, 2 can exchange information between them, i.e. information that is not provided to end user station 1 of segment 1 but which is provided to end user station 4 of segment 2 can be provided to end user station 1 from end user station 4. This however relates to one particular implementation. Of course there may be several segments without any communication between the user stations for exchanging information that is not exactly the same in two different segments etc., but wherein different segments receive segment proprietary multimedia content information pushed to them. General for any implementation is that when an end user requests a CDU or any multimedia content, it can be retrieved from the local cache or local storing means in, or associated with, the end user station, PDA, itself, and then presented locally to the end user, whereby the content is selected in a customized manner, at a customized time.

In Fig. 1B end user stations 1, 2, 3 are connected to WLAN segment 1, stations 4, 5 to segment 2 and stations 6, 7 to segment 3. Of course only a few stations are illustrated, and in this figure the local, proprietary push caching means are not explicitly illustrated but they are supposed to be comprised in the end user stations.

According to the invention, since multimedia content, e.g. clips, is already available in the local, proprietary cache of the end user station, which may be mobile or not, handheld or not, then playback can in principle start almost instantly. A traditional cache on the contrary pulls data from a secondary storage when the data is requested by higher level system, e.g. a CPU (Central Processing Unit). The data is then kept in the cache until the space is needed for other data. The underlying assumption behind pull caching is that data that has been used once will be used again in the near future. Pull caching traditionally has been enhanced with pre-fetch where the cache mechanism tries to anticipate what will be requested next, and proceeds to fetch that from the secondary storage. An example thereon relates to surfing on the web when it is more likely that the user follows a link that is visible than one that is not visible.

According to the invention, however, data is instead pushed to the clients. Ideally it is possible to push all available data to the client device or the end user station, so that it would be available instantaneously upon user request. The central server of the inventive system determines what to push to the respective clients for example based on available multimedia content, or data information in general, usage statistics, client reports on cache content and other factors. It should be clear that these only constitute an example on some factors, other factors can also be used to determine what should be pushed. The end user stations

then receives data from the server as multicast or broadcast streams.

Fig. 2 schematically illustrates a system according to one embodiment of the invention. The emphasis is based on the central server side 100, merely indicating the client side with the end user stations 20_1, 20_2, 20_3. The central server means 100 in this implementation comprises a master cache control engine 10 controlling a number of segment cache control engines 11A, 11B. In this implementation there is one segment cache control engine 11A, 11B for each WLAN segment, WLAN segment 1 30A illustrated as well as a second WLAN segment 2 30B indicated within dashed lines, as well as the segment cache control engine 11B. Segment cache control engine 11A controls WLAN segment 1 30A, whereas the segment cache control engine 11B controls WLAN segment 2 30B. In this implementation there is one segment cache push engine 13A, 13B for each segment. The respective cache push engines transmit multimedia content or data information such as live content, content clips, files, applications etc. using multicast or broadcast to the end user stations of the respective WLAN segments. Thus, in this implementation segment cache push engine 13A pushes multimedia content to end user stations 20_1, 20_2, 20_3. In a similar manner segment cache push engine 13B pushes multimedia content via multicast/broadcast to WLAN segment 2 30B. The respective segment cache control engines 11A, 11B control the respective segment cache push engines 13A, 13B respectively through information from segment transmission scheduling means 12A, 12B. Information about the transmission schedule is also communicated to the end user stations (20_1, 20_2, 20_3) in the respective WLAN segments and, in a particular implementation, also to logically neighbouring segments if for example somewhat different multimedia content is pushed to neighbouring, partly

overlapping segments, e.g. if Bluetooth or a similar system is implemented (cf. Fig. 1A).

In another implementation more than one, or several segments share a segment cache push engine.

The master cache control engine 10 in addition to controlling the segment cache control engines, also coordinates the transmissions from the respective segment cache control engines, for example such that a variance detected in one segment can be met proactively in another segment. In addition thereto it coordinates transmission schedules (if intercommunication e.g. according to Bluetooth is implemented) and it also is responsible for handling user segment roaming. It is here supposed that multimedia content is stored in the central media storage 14. This can also of course be seen as a combined entity with the master cache control engine and/or with the segment cache control engines. Of course there may be more than two different segments as well as there may be just one segment; two WLAN segments here being illustrated for illustrative purposes. The pushed content is thus preferably location dependent.

In still another implementation there are not necessarily subordinate and superior control engines provided, but one and the same control engine could be responsible for more than one segment. Also the segment transmission scheduling means could be combined for more than one segment. The main thing is that multimedia content is pushed by multicast or broadcast to end user stations without having been requested for storing locally in the respective end user stations of a given segment. Particularly it is location dependent, but also other criteria could apply. As a user station enters an area, e.g. a cell or anything else, the relevant information can be pushed to it.

The establishment of the transmission schedule is a complex and important function. The general intention is to minimize the delay from a user request until the requested information can be presented, e.g. in one particular implementation to minimize delay from user request until the playback of a clip can start, such that a given number of the clips will start within e.g. 0,5 seconds and all clips will start within e.g. 5 seconds. This is of course only one particular implementation and also the figures are given for examplifying reasons. The transmission scheduling algorithm can take account of different factors depending on localization and situation etc. but for example it should also take other factors into account, such as estimates of available content and content to be produced. It could also be based on factors such as estimates of available content in each end user station or client device in the concerned segment as in a transmission loss model, a client cache-content expiration model, statistics reports from clients and specific requests from clients. It can also be based on factors such as predictions relating to user requests such as a domain model mapping events to requests, statistics reports from clients and historical data.

In one implementation one multicast/broadcast session is used to transmit several clips (for example). Alternatively a new session is opened for each clip. Still further could either a single multicast/broadcast session be used for each parallell distribution channel or alternatively could several multicast/broadcast sessions be used for each parallel distribution channel.

In one implementation two processes in one user station are able to listen to the same multicast/broadcast stream transparently which would make it easier to playback live content and save

content clip at the same time. This is however not necessarily the case, but it merely relates to one specific implementation.

If for example Bluetooh or a similar technology is implemented, and if for example a clip is unavailable from the local cache and from the central server means, the client of an end user station could request it from a neighbouring end user station, the client devices e.g. using a Bluetooth connection. The network could for example be set up such that segments overlap geographically and transmit a partially heterogeneous data set to each segment. The client would then be responsible for diffusing the different data further to other clients.

Generally the central server means can be said to, in one particular implementation, comprise a hierarchical dispatching architecture, comprising two different levels. It is supposed that the network is divided into segments, and each segment substantially corresponds to an access point and comprises all end user stations that are able to communicate directly therewith.

The end user stations receive data from the central server means through multicast or broadcast multimedia content streams or data information streams. In Fig. 3 a block diagram illustrates one embodiment of an end user station 20. In a conventional manner it comprises a user client 21 with a conventional user cache 22. In addition thereto it comprises a local, proprietary, local push cache 23 particularly for push content. In this implementation the actual storage is supposed to be a cache storage whereas the local push cache comprises a local push cache engine, e.g. a proxy. It is supposed that the end user station 20 receives content information from the central server means, cf. Fig. 2, which is stored as content information or presented to the end user e.g. on the display for example as a list 25, and that using said

information, the end user enters a request that is provided to the user client, which in turn forwards the request to the local push cache engine 23 which fetches the requested content if available, from the local push cache storing means 24. The cache, may for example contain live content or clips, video, files, web pages etc. To the end user station can for example multicast/broadcast live content be provided, multicast/broadcast content clips, but also unicast retransmissions. In order to assist in the establishment of the scheduling information, reports and requests are provided to the central server means. In one implementation it is supposed that the end user selects a clip from a play-list if the clip is indicated in the content information presentation means 25. In one implementation, for example in the sport arena IT system, the list may be visualized as a time line display. This is however one specific example. The selection made by the end user initiates the user client that makes a call using IP loop-back to the local push cache engine 23. The user client can be any commercial off-the-shelf player as long as it can be set to access content through a local push cache, e.g. implemented as a proxy or the play-list can reference for example clips as coming from a local "server", i.e. the local push cache 23.

If the requested content is available in the local push cache 23, 24, it will be transmitted to the user client in the conventional manner. If the request concerns live content such as for example a live video stream, it will either first be spooled to the push cache storing means 24 (or rather the local push cache 23 if it is implemented as one single component), or the user client will be able to connect separately to the multicast/broadcast live content stream. If however the content, e.g. a clip, is not available in the local push cache, the local push cache engine 23 will look in the transmission schedule (or list) that it receives from the server. If the requested content is scheduled for transmission

within for example a given number of seconds, the local push cash engine will wait. Otherwise, i.e. if it is not scheduled for transmission within the given time limit, the local push cache engine will request a retransmission from the central server means. The central server may then deny the request, change the transmission schedule to accommodate the request or send a separate unicast to the end user station.

Some content that is already available in the local push cache will be re-received. The client can use such retransmissions to improve the quality of the content in the local push cache, for example by replacing missing frames or by weighing frames to minimize the perceptual error rate.

Through the present invention it gets possible to distribute multimedia content, files, multicast/broadcast live content or clips on demand to end user stations, also to a huge number of end user stations within a small geographical area who all for example are "watching" one and the same event and where the content is related to the event over wireless carriers to the end user stations.

Fig. 4 schematically illustrates block diagram on a functional level of one implementation of the invention, wherein the central server means comprises a transmitter/scheduler module communicating with a master cache storage from where it receives and fetches information, which in turn is provided to both the transmitter/scheduler module and to the master cache storage by some kind of a producer of the multimedia content. Using multicast (or broadcast) information is then pushed over a WLAN (Wireless Local Area Network) to receiving RX module of an end user station which communicates with a local, proprietary push cache in communication with, here, a player and a browser. This

implementation actually presupposes that the network problems are negligible and that the local proprietary push cache substantially never overflows. It does also not support HTTP-push.

Fig. 5 is a block diagram on a functional level illustrating another implementation of the inventive concept. In this implementation transmission scheduling means communicate with a transmitting module (TX), which here are shown as two separate entities and, like in figure 4, communicating with the master cache storage, the content being provided by some kind of producer. In this implementation it is supposed that an encoder is provided on the central server side, whereas a decoder is provided on the client side. Thus, the end user station comprises a receiving module and a local push cache engine in the form of a proxy communicating with the local (push) cache storage. The proxy communicates with a player and a browser. The scheduling information is transported separately between scheduling means over the WLAN and the proxy and the receiving module, and the transmitting and receiving modules communicate over the WLAN via an encoder and a decoder. The implementation according to Fig. 4 actually requires that the producer constantly is provided with feedback information relating to the available space in the respective local push caches to prevent overflow. If the multimedia content relates to e.g. video, it is supposed that the producer decides what sequences should be picked out for the replay list. The video is encoded using a standard or de facto standard encoder which in turn uses a standard or de facto standard CODEC supported by the targeted end user stations, e.g. PDAs.

A cache data unit (CDU), as referred to earlier, may for example be represented by a CDU description file which may contain a CDU description file name, title text, date and time of the event in

the CDU, play length, file name, container format such as for example Windows Media Technologies, Real Media etc. It may also contain CDU comments and other information, or only a part of the above mentioned information.

It is supposed that the central server upon initialization reads initialization parameters containing for example the path to the CDU description files, the path to the CDU files themselves, session parameters etc. The server then checks the parameters and sets up the environment and starts to continuously send the session parameters to a known and established multicast/broadcast group address.

Fig. 6 schematically illustrates one example on a scheduling algorithm. Cyclic retransmission can be used where the CDU is constantly retransmitted to the clients. In very large networks and where the amount of CDUs is relatively small this is a preferred implementation. Alternatively retransmission can be requested when the CDU is sent on request to the clients. Using such an approach, the whole event can be made ready for replay. Block 100A in the figure indicates an item consumed from the TX queue. If the retransmission mode is set to cyclic, 101A, then the CDU description file is put on the transmission queue 103, 103A. Block B in the figure illustrates request/report from the client. The scheduler then checks, 101B, if the incoming request has already been dispatched and if it is a duplicate. If the item is in the queue, 103, the priority will be increased, 104, otherwise the CDU, 106, 106A, 106C, is added to the transmission queue together with a CDU description 106B. This is relevant for requests or reports from the client, item consumed from the TX queue and for generated CDUs (i.e. 100A, 100B, 100C). However, when a new CDU is generated (block 100C), the scheduler will be informed thereon. If push is configured to be used, 101C, the CDU

is queued on the transmission queue. If "no" results in steps 101A, 101B and 101C, nothing is done (102A, 102B, 102C). After a CDU has been added to the TX queue, 106, and the activity log has been adapted, 107, the procedure is completed, nothing is done, 108.

The TX module or transmitting module, simply consumes items from the TX queue, and passes them on to the encoder and to the network. This is more thoroughly illustrated in Fig. 7 giving an example of a TX module procedure. The TX module checks if there is anything in the TX queue, 200. If yes, if there is a clip in the master clip (cache) storage, the clip is together with metainformation (content or scheduling information) transmitted to the established, relevant multicast/broadcast group, 201; 202. If the push multicast/broadcast is successful, 203, the clip and the metainformation is removed from the TX queue, 205. Otherwise the exception is thrown, 204. Then see 100A of Fig. 6.

The CDU description file is sent together with the CDU file to the multicast/broadcast group found or established by means of information in the session parameters. The scheduling means is also notified. The transmission queue is investigated, and the first entry found is transmitted and removed from the queue. If retransmission mode is "cyclic", the entry is added again to the queue (206).

In one implementation data compression is implemented on a wireless network if it has a positive effect. It is not useful on information that already has been compressed. In any case, the benefits of implementing compression should be weighted against the benefits of redundancy.

The encoder, cf. Fig. 7, will accept CDUs from the TX module and transmit them over the network to the client. In one simple implementation, the file is sent as it is. In an alternative advantageous implementation a transmission scheme could be used. Files are then divided into fragments which are redundancy coded and overlapping. Fragments are sent over the network to the decoder. In order to avoid losing too much information from one file, several files can be sent in parallel. The level of redundancy and parallelism can be adjusted adaptively to minimize file losses while keeping latency at an acceptable level. This is to take account of packet loss problems. Which encoding method that is used, depends on the type of file to be transmitted. Data loss or corruption is for example unacceptable in an HTML-file whereas it can be tolerated in a video CDU. Thus, different encoding methods can be used according to different embodiments and also depending on content to be transferred. On the receiving side, i.e. in the end user station, the decoding means will reassemble the fragments and pass them on to the receiving RX module. If the client is in reporting mode, the decoder will include data on the reception quality in the report from the end user station or the client to the central server means.

The inventive concept can be implemented for difference kinds of wireless networks such as wireless LANs, wireless WANS like UMTS (WCDMA), GSM, GPRS etc. One example of a wireless LAN is standardized in IEEE 802.11. Following this standard, all multicast/broadcast traffic is sent using the BSS Basic Rate Set Speed. This is the lowest speed configured in a multi-rate network. Multicast/broadcast may be configured to use the speed the slowest client (end user station) can handle. In another wireless LAN, HIPERLAN/2, multicast/broadcast traffic is sent on a common multicast/broadcast channel at the highest bit rate. The

addressing scheme of HIPERLAN/2 would however have to be modified for supporting big networks.

Fig. 10 below will schematically illustrate how the inventive concept could be implemented in WWAN (Wireless Wide Area Networks) such as UMTS, GSM/GPRS etc.

In one implementation, based on IT technology, upon client initialization, the client will start to try to receive session parameters on a common, fixed well-known multicast/broadcast group address. The session parameters comprise information about version, addresses and retransmission mode. Necessary checks and initiations will be performed, and it is possible to change or switch address if the multimedia content is provided on another address. With such an implementation it is possible to reconfigure after initialization and the system is up and running.

Fig. 8 schematically describes one example on a procedure in the receiving module. The receiving module receives data from the decoder at the transmitting (central server side) (over the client receiver) and it will store the data in the local push cache storing means. If the local push cache already is full, it will attempt to get some free space for the received content and then store it. However, if it is not possible, the received data information, particularly CDU, will be discarded. In Fig. 8 the received content is referred to as CDUs. It is thus in Fig. 8 supposed that the RX module receives a CDU and additional metainfo, wherein the metainformation comprises a content list or similar, 300. It is then possible to temporarily store the CDU and the metainformation, 300A. Subsequently it is examined whether there is a pending request for the particular CDU, 301. If yes, reference is made to 403B of Fig. 9 describing the procedure of a local proxy cache handling means that is implemented for this

particular implementation. If not, according to an optional step, it is possible to calculate the reception quality, 302. This may also be done in case there is a pending request for the particular CDU. If the reception quality is acceptable, which is established in an examination step 303, it is proceeded to a step examining whether there is any available space, 304. If the reception quality is established not be acceptable, it is examined whether the RX module is in a request mode, 303A. If yes, a retransmission request may be sent, 303C. If it is not in a request mode (303A), but also if a retransmission is requested, the received CDU and the metainformation is scrapped, 307. In step 304 examining if there is any space available, the result may be that there is no space. Then a cleaning up step 305 is performed to for example dispose of no more relevant content, whereupon it is again examined if there is any space available, 306. If not, it is proceeded with step 307 as referred to above wherein the CDU and the metainformation is disposed of. If it however was established that there now is space available, the CDU and the metainfo is stored into the proprietary, local push cache, 308. Both if the CDU and the metainformation is stored or if it is disposed of, it may be proceeded with a reporting mode, 309 or it may be examined if a reporting should be done. If yes, information about the outcome is added to a report, 310, which may be transmitted or not, 311, 312. If not, i.e. if no reporting mode is implemented, or after transmitting a report, or if an indication is received that the report should not be transmitted, it is returned to step 300 above, i.e. awaiting reception of a new CDU etc.

It should be clear that, as an alternative to steps 301 etc. above relating to discarding of CDU and metainformation if the quality is not sufficient, it is possible to store the CDU (and possible metainformation) with an inferior quality into a storing means, and add it to a subsequent transmission of a corresponding content

such that for example two half clips can be added, as a quality increasing method. Also other implementations are possible.

In this implementation it is referred to implementation of a proxy with a proxy handler. It is however not necessary to implement a proxy. However, if there is a possibility that the cache will overflow, it will be necessary or at least advantageous to use a proxy to deal with requests which cannot be fulfilled from the cache. This is examplified in Fig. 9 describing the local proxy cache handler. As referred to above it is supposed that the local proxy cache handler is an awaiting stage for reception of a request, 400. Since supposed that the request is received, 401, with reception of request parameters. Then it is examined if the request is correct, 402. If not, it indicates a failure, 402A. If the request however is established to be correct, it is examined whether the request is for content already in the cache, 403. If not, then advantageously an urgent retransmission request is sent, 403A, whereupon it is awaited a response, 403B, cf. step 301 of Fig. 8. If it is established however that the content is already in the cache or when waiting for a response, 403B, the request is served, 404, whereupon the procedure is finished for that request, 405.

If a local proxy server is implemented, the CDU can be accessed through an IP loop-back instead of directly from the file system. This provides a higher degree of controllability, but on the other hand, the overhead will be somewhat higher.

A local proxy server is advantageous in that player transparency will be provided. However, irrespectively of whether an implementation is used which includes a proxy or not, application transparency will be provided for.

In a somewhat simplified implementation, the user may access a CDU index HTML page, which is stored locally, where the links to the locally stored CDUs are using an ordinary Internet Browser, for example Microsoft Internet Explorer, Netscape Communicator or similar. The browser will then pick the correct video player (in case of video) according to the file extension and play the file locally. Such an implementation, however, does not support HTTP-push of content. Generally, with or without a proxy being implemented, application transparency is provided.

It should be clear that, throughout the application, when referring to an end user station, it could refer to a PDA, a mobile phone, a mobile terminal in general or to any other wireless equipment.

Moreover, even if it mainly has been referred to WLANs, the concept also covers implementation in wireless WANs, cf. Fig. 10, such as GSM/GPRS, UMTS etc. Fig. 10 intends to illustrate the implementation both to GSM/GPRS (left part of the figure) and to UMTS (right part of the figure).

Multicast/broadcast is a technique that does not exist in GSM or UMTS today but broadcast does. The CBS (Cell Broadcasting Services) is today used to inform the User Equipment (UE) (i.e. end user station) about general cell information, like what channels should be used etc.

3GPP has just initiated standardization of multicast/broadcast in 3G networks. It is called MBMS (Multicast/Broadcast Multimedia Services). This service will support higher bit rates than CBS.

For Cell Broadcast Services in GSM, the Caching CBE (Cell Broadcast Entity) of the central server means, 100B, with a Push

Cache Manager sends 82 octets of the data (CDU etc) in a "WRITE-REPLACE"-request to the CBC (Cell Broadcast Centre), 101A, located in the Core Network. The CBC, 101B, adds a CBS header and transmits to the BSC (Base Station Controller), 102B, which adds a 6 octet header and forms messages of 88 octets each. The message is transmitted to the BTS (Base Transceiver Station), 103B, or RBS (Radio Base Station), which splits the 88 octets into four 22 octet pieces and sends them on the air (400 bps) to the UE (User Equipment), 20D. The UE assembles the packages and hands them over to the Push Cache Client, 21D.

For Cell Broadcast Services in WCDMA (UMTS), the Caching CBE (Cell Broadcast Entity) of the central server means, 100B, with a Push Cache Manager (server), sends 82 octets to the data (CDU etc.) in a "WRITE-REPLACE"-request to the CBC (Cell Broadcast Centre), 101B, located in the Core Network. The CBC, 101B, adds a CBS header and transmits to the RNC (Radio Network Controller), 102C, which adds a 6 octet header and forms messages of 88 octets each. The message is transmitted through the Node-B, 103C, and sent on the air (20 kbps) to the UE (User Equipment), 20E. The UE, 20E, assembles the packages and hands it over to the Push Cache Client, 21E.

Generally it will not be possible to solve the problems initially referred to in a conventional manner when there are about 50 or more end user stations gathered in a so called hotspot. Implementing the inventive concept will however be advantageous also for fewer end users and there are also other aspects, such that if for example an end user enters a hospital, any public complex, university, any railway station etc. the relevant content could be automatically pushed to the user which, could be presented with it quickly on request irrespectively of whether

there are many other end users together at the same spot connected on the same wireless LAN.

In a particular implementation feedback relating to reception and content of the local push cache does not have to be provided from all clients in a segment. Reporting could be delegated to only some specified clients based on some allocation algorithm such as weighted Round-Robin or similar. In a particular implementation the central server means distributes server cache content lists to the clients.

Particularly a basic Forward Error Correction (FEC) scheme is used comprising cyclic retransmission of CDUs. Generally the server comprises scheduling of cache contents both for cyclic retransmissions and for client request retransmissions. Forward Error Correction (FEC) used to the multicast/broadcast is generally needed in order to minimize client traffic, e.g. to avoid acknowledgement implosion. As an alternative to a standard player a local streaming server can be implemented.

One way of implementing a reliable multicast/broadcast method is to send each packet twice, or even thrice, and also to interleave packets from all CDUs in the cache content list. In one implementation open source implementation of a HTTP server can be used as a local push cache. The invention is of course not limited to any particular HTTP or streaming servers/proxys.

Generally the transmission queues are managed as tree queues, a cache contents list queue, request transmission queue and a cyclic retransmission queue, cf. Fig. 6.

According to the invention the client traffic should be minimized as much as possible. In one implementation clients listen to other

requests on a multicast/broadcast channel and send only unique requests. Acknowledgement of what will soon be sent from the central server will also decrease a number of client requests. Without cache content lists or similar it is generally not possible to do any prioritizing in the local push cache. One way of solving this problem could be via pending metadata at the end of the CDU and include the files in each packet, which relates to a most advantageous implementation.

One particular implementation of the invention relates to offer reruns and video etc. on demand to a PDA over an IP network at for example a sports arena or similar having thousands of spectators many of which having Personal Digital Assistants. To provide individual data information such as audio/video information to the videos, multicast/broadcast streamed live content (audio/video) or content clips can be pushed to the end user stations. The receiving end user station may or may not show the received content, but it always saves it in the local push cache or tunes in to a multicast/broadcast address. To preserve memory it is possible to letting an audio/video producer signal, on the multicasting/broadcasting stream, to the end user station when interesting events have occurred. The local push cache in the receiving end user station keeps only the last n seconds, n being a customizable number of seconds before, and another m seconds after the event which (m) also is customizable. The signal, from the video producer (or similar) starts a process that will initiate storing in the cache for later use. It also stores the next m seconds in the cache, so that the end user can enjoy n + m seconds before and after the event. During the process an index page can be updated to support later rerun retrieval. This way of preserving memory is efficient when a memory, which is large, at the receiving end can hold both a cache and the stored content

(audio/video) and when it is essential that the reruns are sent quickly after the event.

Another way of preserving storing capability or memory is by having an (audio/video) producer record the event locally, maybe edit it and IP multicast/broadcast the streamed reruns to the receiving end user stations. All the receiving end user stations store it locally in the background and update an index for rerun retrieval later by the user. The rerun clips are e.g. 5 to 20 seconds long or whatever is needed to reflect the event properly. This method is efficient when the memory is of medium size, and can hold both the stored content (audio/video) and when the time to play the rerun is not critical.

Alternatively, a producer may perform recording locally, may be edit it, and only IP multicast/broadcast streamed reruns to the receiving devices on different IP multicast/broadcast addresses for each clip. All the received end user stations in the receive an index describing the clips with links to the appropriate multicast/broadcast address. The rerun clips are for example 5 to 20 seconds in length and are sent cyclically every 5 to 20 seconds on a specific IP multicast/broadcast address. This method is advantageous when the memory at the receiving end user station is small and can not hold any content (audio/video) clips.

To increase quality, diversity can be implemented as referred to above by duplicating or triplicating video transmissions. The second time a rerun is sent, for example every bit, frame or packet can be combined with the earlier sent sequence, and errors can be discarded. The combining can be soft, meaning that the mean of the combined sequences is used, or it can be hard, meaning that a majority decision is used per packet or block size.

Clips or CDUs can be retransmitted continuously to the end user stations in such a way that an optimization is achieved for each segment, whereas segment as referred above relate to those end user stations which share a common radio carrier frequency and access point. It is also possible to continuously retransmit each clip such that the time to wait for a clip will be limited.

Still further each end user stations could be presented with a list from which it is possible to select multimedia clip (or live content). The system may analyze the current network load and produce a rerun multimedia consisting of n seconds before and m seconds after the event, n + m being bounded upwards by the current system load, i.e. taking network load situation into consideration. The n and m figures are limited downwards by the necessity to provide an understandable and meaningful multimedia content presentation.

A particular implementation provides for streamed reruns or IP multicast/broadcast to receiving end user stations on different IP multicast/broadcast addresses for each clip of a number of clips whereas the receiving end user stations also have received an index describing the clips with links to the appropriate multicast/broadcast addresses.

It is also possible to simply tag or provide the CDUs or multimedia content pieces with an identification instead of a separate list.

In particular implementations a solution is provided through which delays in a video producer in action time can be adjusted for, relating to when important events are signaled or similar. In one implementation the runtime of e.g. a video clip can be made much larger than the measured or variable reaction time. Alternatively

the runtime of for example a video clip can be made much larger than a fixed maximum reaction time. Alternatively justification of the clip sizes can be done afterwards in a later iteration. Events or similar to be presented can be automatically sensed and signalled. Alternatively manual indication can be implemented for sending signals relating to content that should be made available to end user stations within a segment.

It should be clear that the invention, of course, not is limited to the specifically illustrated embodiments, but that it can be varied in a number ways without departing from the scope of the appended claims.

CLAIMS

1. A system for communication of data information, e.g. multimedia content, over a wireless network connecting a plurality of end user stations and supporting broadcast/multicast transmission, c h a r a c t e r i z e d i n that it comprises central server means with at least one central cache arrangement for storing at least selected parts of data information relevant for at least a segment of the wireless network, transmission scheduling means for transmission scheduling, central cache arrangement control means for, by using scheduling information, controlling a central cache arrangement push engine for multicast/broadcast pushing of information to end user stations within said at least one segment of the wireless network, and in that the end user stations comprise or are associated with proprietary, local push content caching means for holding the pushed data information, and in that upon request by the respective end user, selected data information may be presented to the end user in a customized manner via a user client from said local caching means.

2. A system according to claim 1, c h a r a c t e r i z e d i n that a segment of the network corresponds to a local part of the wireless network.

3. A system according to claim 2, c h a r a c t e r i z e d i n that a segment corresponds to a local part of the network with at least temporarily a large or huge amount of connected end user stations, a so called hot spot, e.g. a sports arena, a public

place for spectacular events or any other localization with a large number of simultaneously connected end user stations.

4. A system according to claim 2 or 3,
c h a r a c t e r i z e d i n
that partly overlapping network segments are implemented.

5. A system according to claim 2, 3 or 4,
c h a r a c t e r i z e d i n
that the pushed data information content is segment dependent, i.e. different for each segment at least to a major part.

6. A system at least according to claim 3 or 4,
c h a r a c t e r i z e d i n
that at least partly the same content is pushed to more than one segment of the wireless network.

7. A system according to any one of the preceding claims,
c h a r a c t e r i z e d i n
that the end user station client is allocated a segment at connecting to the system and entering an area corresponding to the segment or at establishment of an end user usage pattern.

8. A system according to any one of the preceding claims,
c h a r a c t e r i z e d i n
that the data information comprises multimedia information, clips or live, video/audio, web pages, files, applications etc.

9. A system according to claim 8,
c h a r a c t e r i z e d i n
that one multicast/broadcast session is used to transmit several multimedia/video clips/web pages.

10. A system according to claim 8,
characterized in
that a new multicast/broadcast session is opened for each multimedia content, clip/web (page) or file transmission.

11. A system according to any one of the preceding claims,
characterized in
that a single multicast/broadcast session or several multicast/broadcast sessions are used for each parallell distribution channel.

12. A system according to any one of the preceding claims,
characterized in
that the central cache arrangement push engine is responsible for pushing data information content to end user stations of more than one segment.

13. A system according to any one o the preceding claims,
characterized in
that there is one central cache arrangement control means and one push engine for each segment.

14. A system according to any one of the preceding claims,
characterized in
that content information, e.g. lists from the transmission scheduling means is communicated to the end user stations within the concerned segment allowing the end user to select data information for requests, or that the multimedia content is tagged.

15. A system according to anyone of the preceding claims,
characterized in

that the central cache arrangement comprises a number of subordinate cache control engines, e.g. one for each segment, and a superior master cache control engine controlling said subordinate cache control engines, and coordinating transmissions and handling end user station segment roaming.

16. A system according to any one of the preceding claims, c h a r a c t e r i z e d i n that the transmission scheduling means uses an algorithm comprising information about estimated/predicted content and end user demand for minimizing the delay between end user request and end user presentation.

17. A system according to anyone of the preceding claims, c h a r a c t e r i z e d i n that end user inter-communication is enabled for transfer of information from one end user station of a segment to another end user station of another, partly overlapping segment, when partly different information data is provided to the partly overlapping segments (Bluetooth).

18. A system according to any one of the preceding claims, c h a r a c t e r i z e d i n that for end user requests of live, e.g. video, streaming information, the end user station client can connect separately to the live multicast/broadcast stream without having the content passing the local cache.

19. A system according to any one of the preceding claims, c h a r a c t e r i z e d i n that retransmission of content from the central server can be requested, and in that a time limit is given such that if

transmission of the content is due with the time interval, no retransmission is requested from the cache engine.

20. A system according to any one of the preceding claims, characterized in that the wireless network is IP-based, WLAN, HIPERLAN 2,3,4, IEEE 802.11, UMTS, GSM/GPRS, EDGE, PDC, CDMA, WCDMA, CDMA 2000, hybrid networks with DVB and a back channel etc., the push content local caches particularly comprising proxy servers.

21. An end user station in a wireless network supporting communication of data information, e.g. multimedia content, characterized in that it comprises or is associated with a proprietary, local push content caching means for holding data information pushed via multicast/broadcast to the end user station by a central server means controlling data information pushing to at least a segment of the wireless network in which the end user station is connected/located, and in that upon request, selected, customized data information can be fetched from the local push content caching means to the client of the end user station.

22. An end user station according to claim 21, characterized in that it comprises means for receiving information about information pushed, or to be pushed, to the end user station, e.g. a list or a schedule, such that the end user can base requests on said information to select the desired content to be presented at a desired time.

23. An end user station according to claim 21 or 22, characterized in that the proprietary push content cache comprises a proxy.

24. An end user station according to any one of claims 21-23, characterized in that the data information comprises multimedia content, e.g. live video, video clips, web pages, audio, HTML, GIF, JPEG files, applications, sensor data or similar.

25. An end user station according to any one of claims 21-24, characterized in that it comprises a PDA, a mobile phone, a mobile terminal or any other wireless equipment.

26. A central server means in a wireless network, comprising at least one central cache arrangement for storing at least selected parts of data information relevant for at least a segment of the wireless network, characterized in that it further comprises transmission scheduling means, central cache arrangement control means for, by using said scheduling information, controlling a central cache arrangement push engine for automatical multicast/broadcast pushing of selected information to wireless stations connected to said at least one segment of the wireless network.

27. A central server means according to claim 26, characterized in that content information, e.g. lists, relating to the selected data information e.g. multimedia content, video (live or clips), audio, files/web pages is provided to local, proprietary caching means of the end user stations of the segment.

28. A central server means according to claim 26 or 27, characterized in

that the central cache arrangement comprises a number of subordinate cache control engines, one for each of a number of segments, and a superior, master, cache control engine controlling said subordinate cache control engines and coordinating transmissions.

29. A central server means according to claim 28, c h a r a c t e r i z e d i n that it comprises one push engine for each of a number of segments, particularly one for each segment.

30. A method for, in a wireless network, communicating data information, e.g. multimedia content, to end user stations, c h a r a c t e r i z e d i n that it comprises the steps of:

- storing at least selected parts of data information relevant for the end user stations of at least one segment of the wireless network in a central storing/cache arrangement of a central server means;
- performing a transmission scheduling procedure to provide scheduling information;
- using said scheduling information for controlling multicast/broadcast pushing of the relevant data information to the end user stations of the at least one segment;
- providing content information, e.g. content lists, to the end user stations;
- storing, in local, proprietary push content caching means of the respective end user stations, the pushed data information,

such that each of said end user station optionally, in a customized manner, can request and access data information such as multimedia content from its local, proprietary push content caching means.

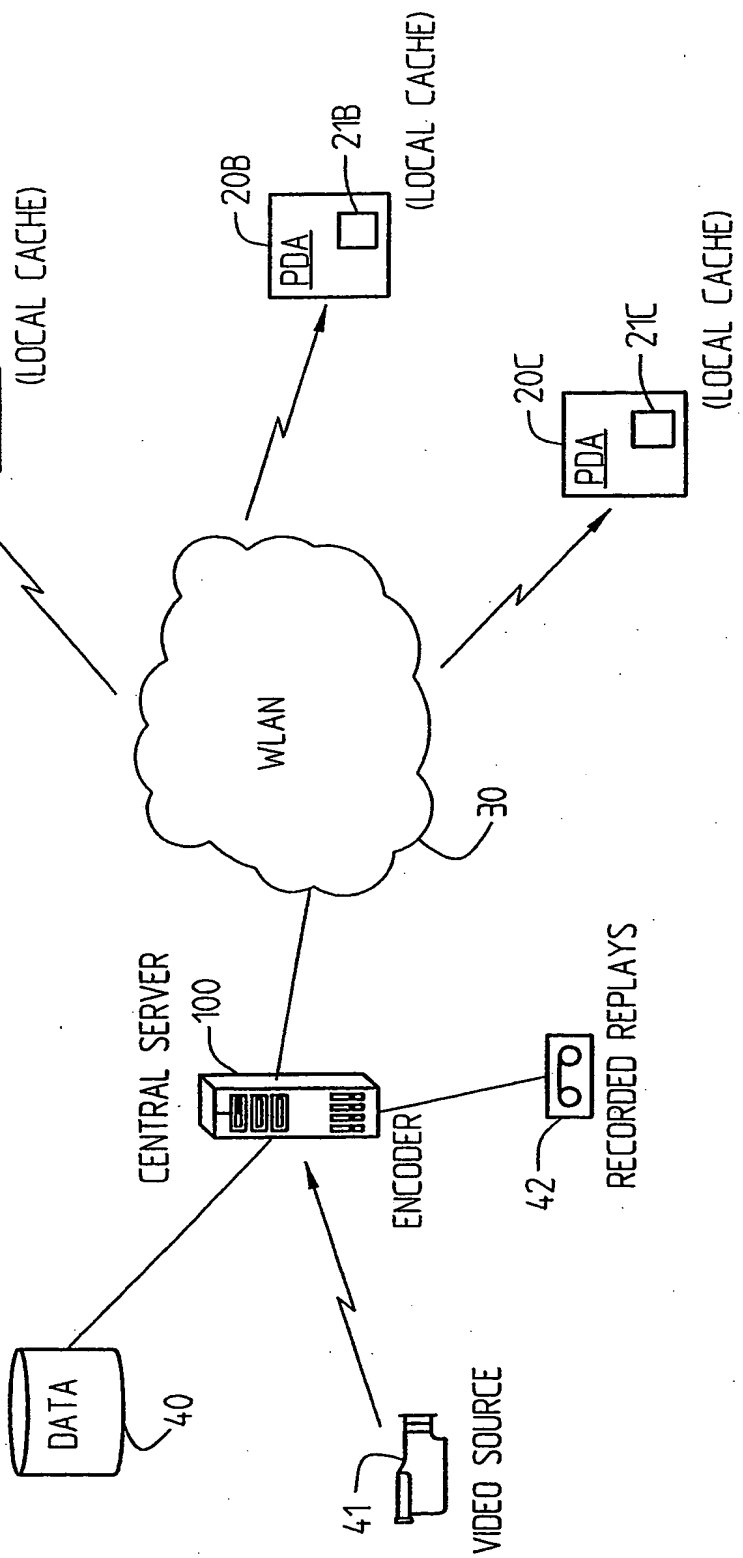
20A
PDA
21A
(LOCAL CACHE)
20B
PDA
21B
(LOCAL CACHE)
20C
PDA
21C
(LOCAL CACHE)
WLAN
30
CENTRAL SERVER
100
ENCODER
42
RECORDED REPLAYS
DATA
40
41
VIDEO SOURCE

Fig. 1A

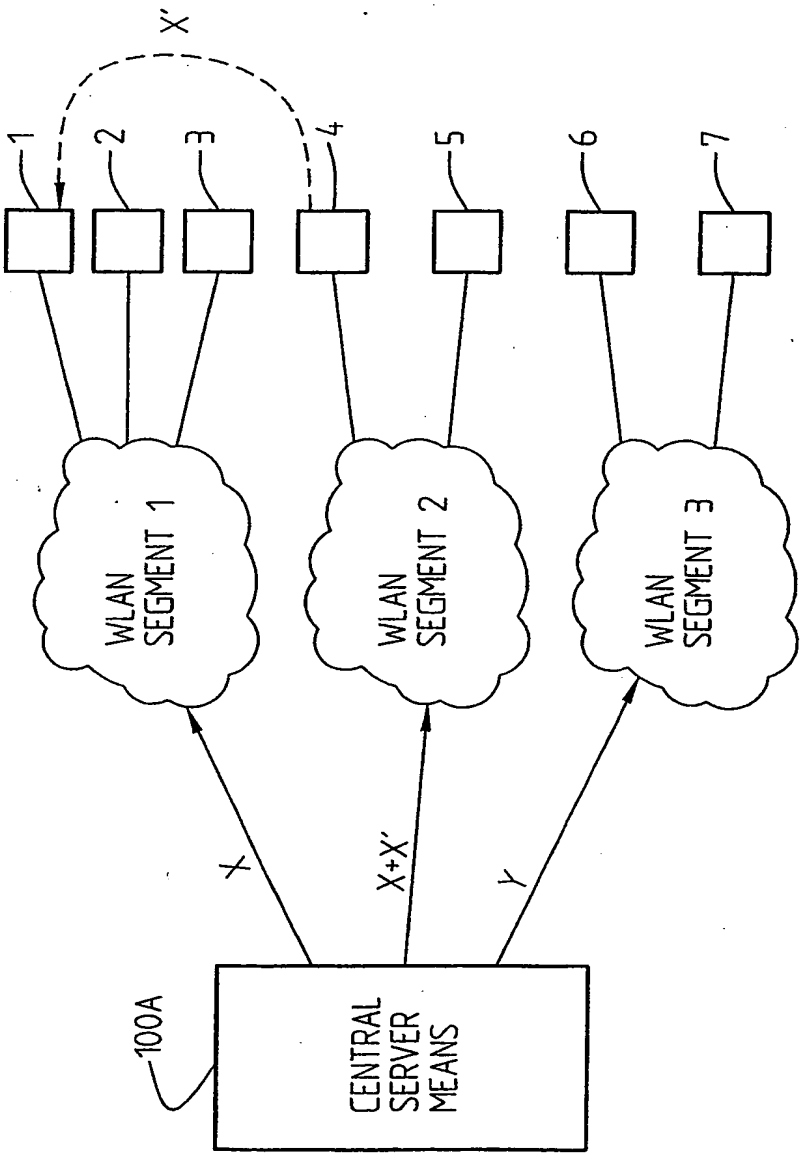
X'
1
2
3
4
5
6
7
WLAN SEGMENT 1
WLAN SEGMENT 2
WLAN SEGMENT 3
X
X+X'
Y
100A
CENTRAL SERVER MEANS

Fig. 1B

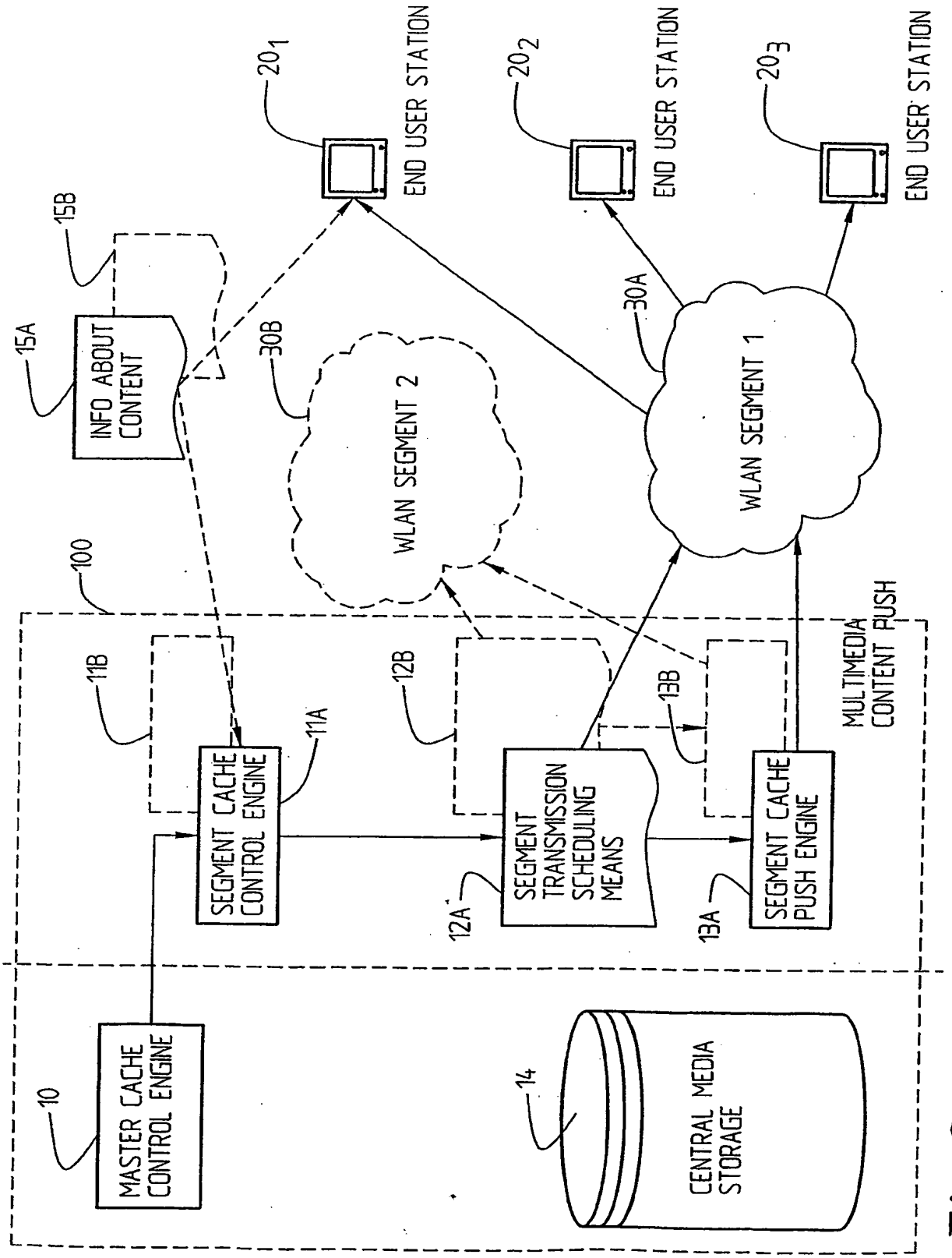
END USER STATION
END USER STATION
END USER STATION
WLAN SEGMENT 2
WLAN SEGMENT 1
INFO ABOUT CONTENT
SEGMENT CACHE CONTROL ENGINE
SEGMENT TRANSMISSION SCHEDULING MEANS
SEGMENT CACHE PUSH ENGINE
MULTIMEDIA CONTENT PUSH
MASTER CACHE CONTROL ENGINE
CENTRAL MEDIA STORAGE

Fig.2

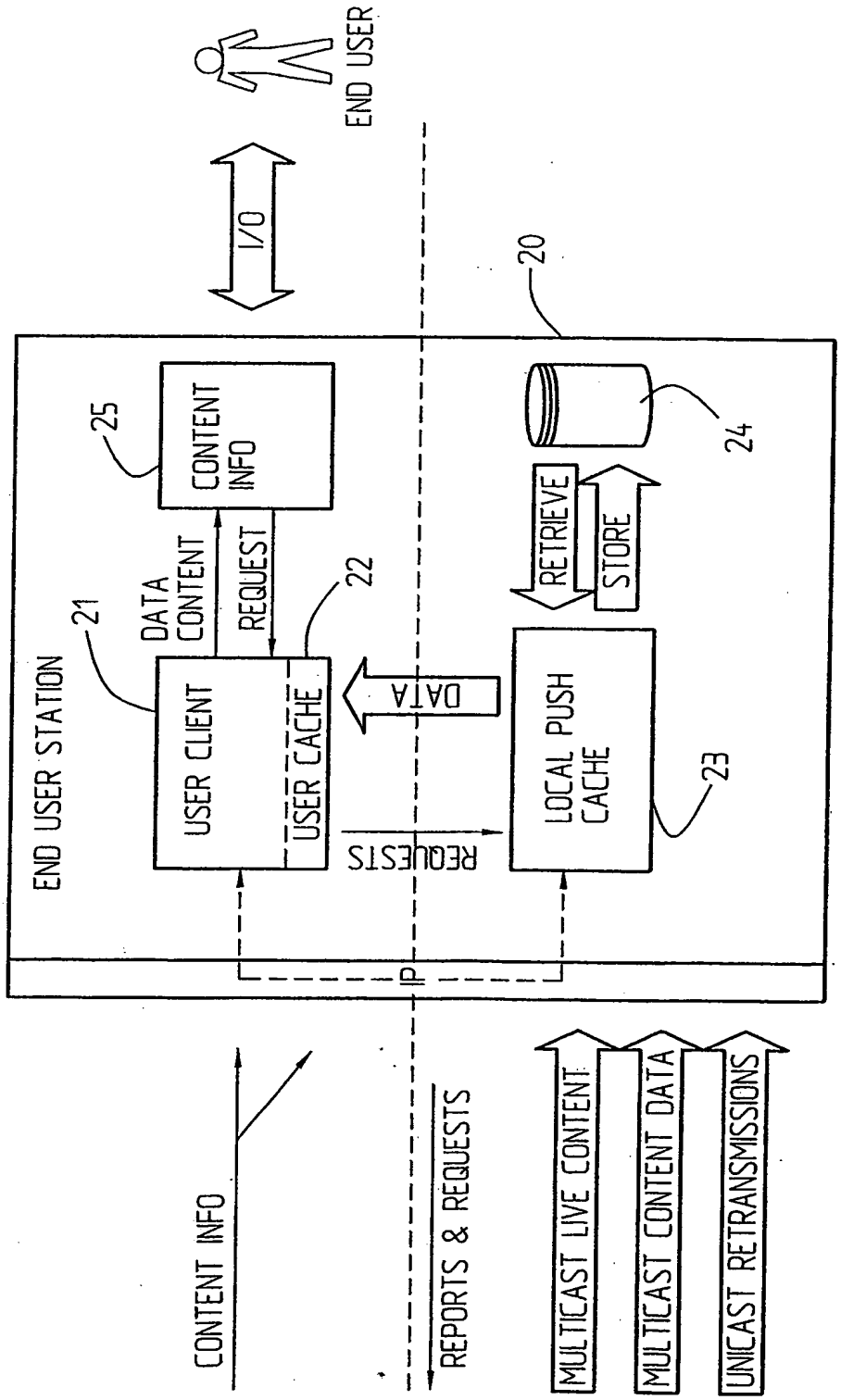
END USER
I/O
20
CONTENT INFO
25
24
RETRIEVE
STORE
DATA CONTENT
REQUEST
22
21
END USER STATION
USER CLIENT
USER CACHE
DATA
LOCAL PUSH CACHE
23
REQUESTS
IP
CONTENT INFO
REPORTS & REQUESTS
MULTICAST LIVE CONTENT
MULTICAST CONTENT DATA
UNICAST RETRANSMISSIONS

Fig. 3

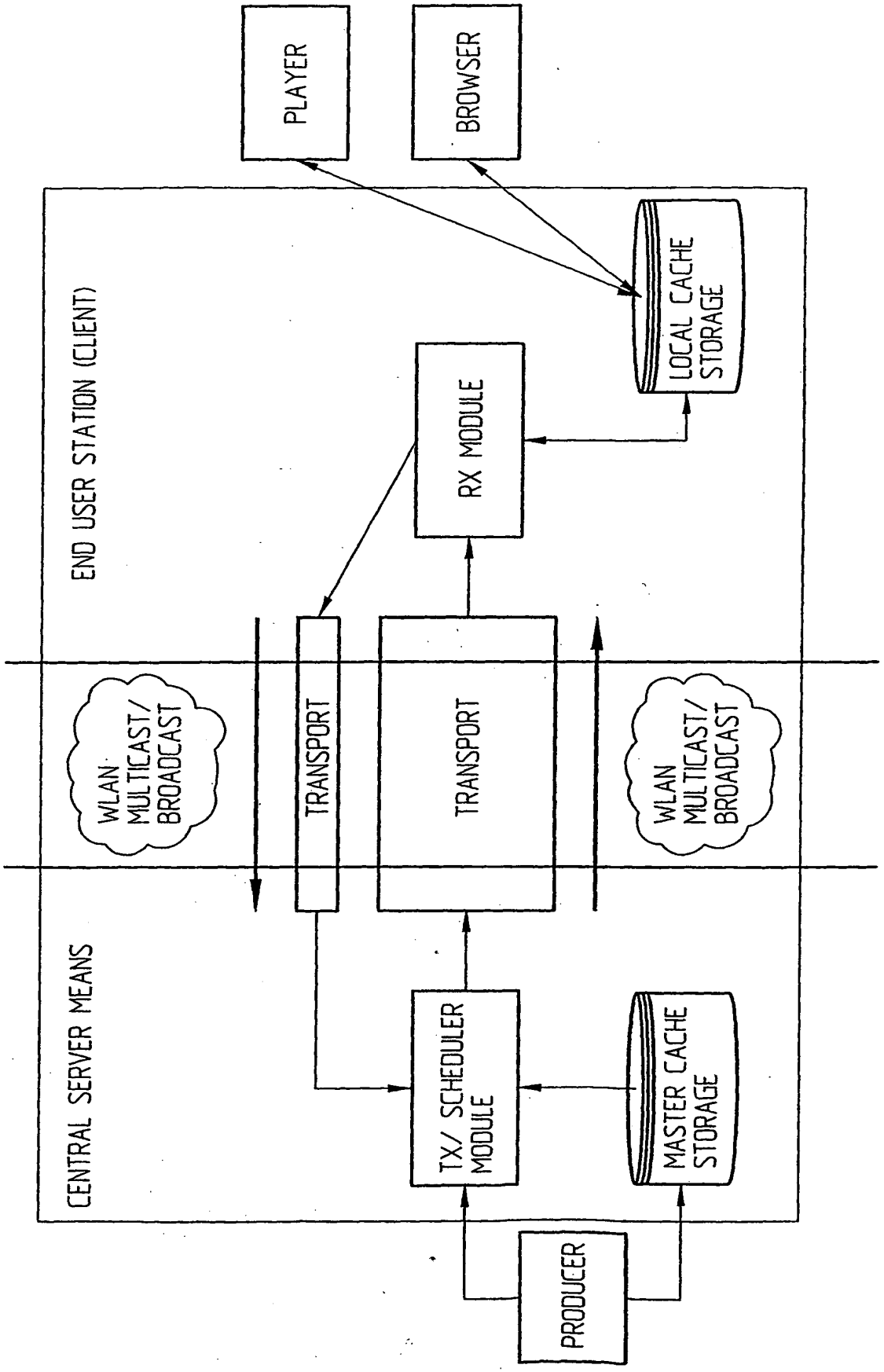
PLAYER
BROWSER
END USER STATION (CLIENT)
LOCAL CACHE STORAGE
RX MODULE
WLAN MULTICAST/ BROADCAST
TRANSPORT
TRANSPORT
WLAN MULTICAST/ BROADCAST
CENTRAL SERVER MEANS
TX/ SCHEDULER MODULE
MASTER CACHE STORAGE
PRODUCER

Fig. 4

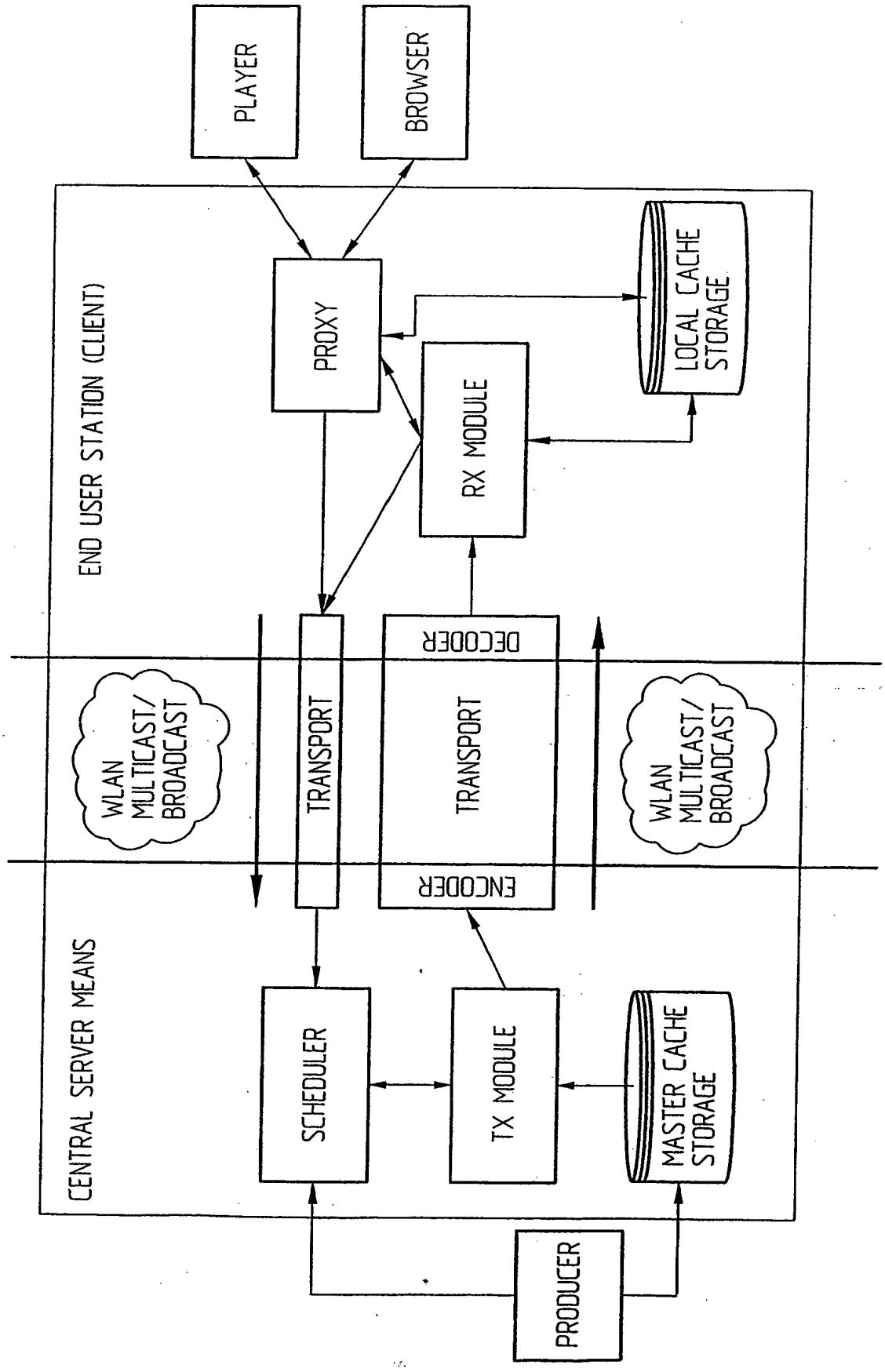
PLAYER
BROWSER
END USER STATION (CLIENT)
PROXY
LOCAL CACHE STORAGE
RX MODULE
DECODER
WLAN MULTICAST/ BROADCAST
TRANSPORT
TRANSPORT
WLAN MULTICAST/ BROADCAST
ENCODER
CENTRAL SERVER MEANS
SCHEDULER
TX MODULE
MASTER CACHE STORAGE
PRODUCER

Fig.5

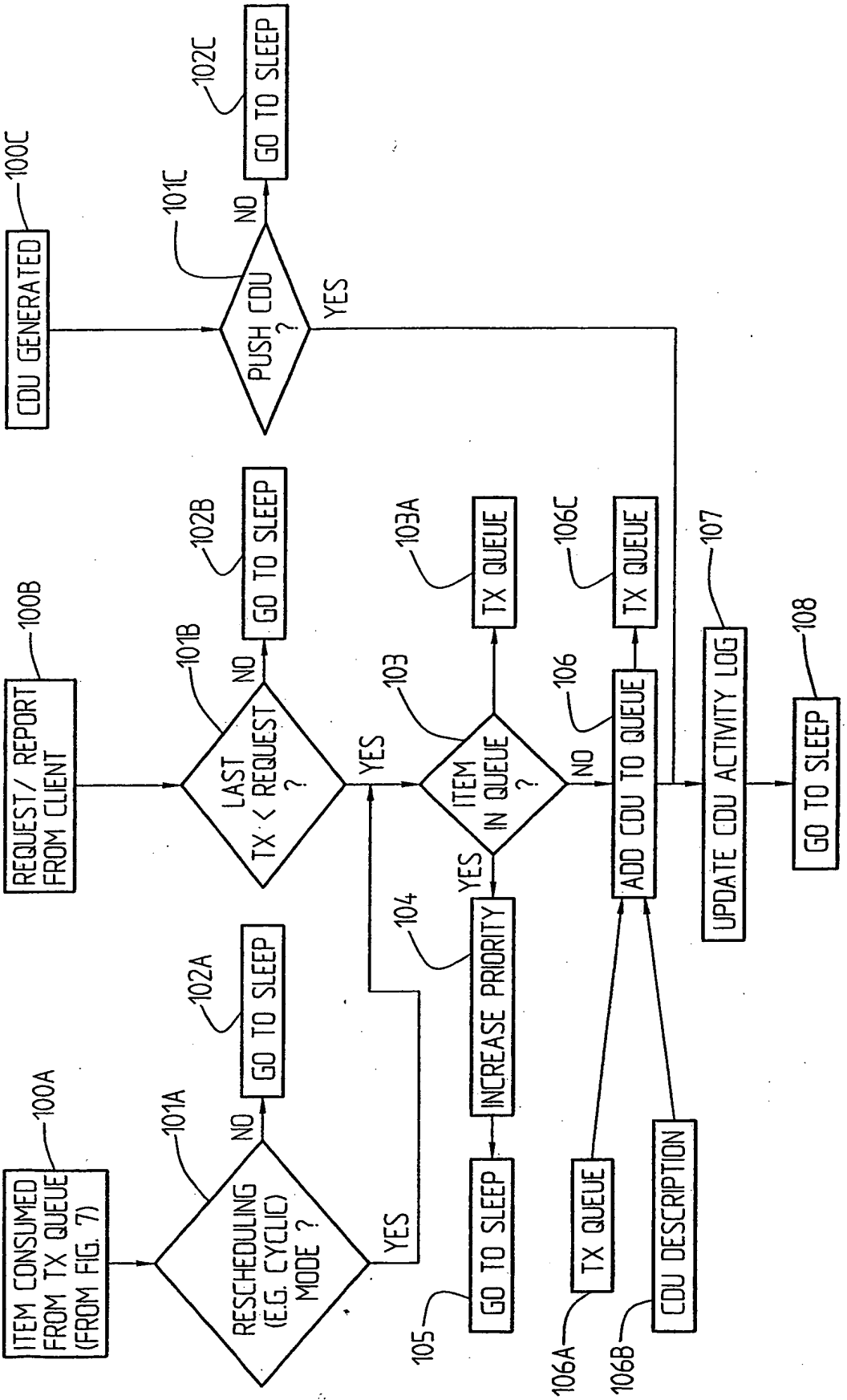
ITEM CONSUMED FROM TX QUEUE (FROM FIG. 7)
100A
RESCHEDULING (E.G. CYCLIC) MODE ?
101A
NO
GO TO SLEEP
102A
YES
REQUEST/ REPORT FROM CLIENT
100B
LAST TX < REQUEST ?
101B
NO
GO TO SLEEP
102B
YES
ITEM IN QUEUE ?
103
YES
INCREASE PRIORITY
104
GO TO SLEEP
105
NO
TX QUEUE
103A
ADD CDU TO QUEUE
106
TX QUEUE
106A
CDU DESCRIPTION
106B
TX QUEUE
106C
UPDATE CDU ACTIVITY LOG
107
GO TO SLEEP
108
CDU GENERATED
100C
PUSH CDU ?
101C
NO
GO TO SLEEP
102C
YES

Fig. 6

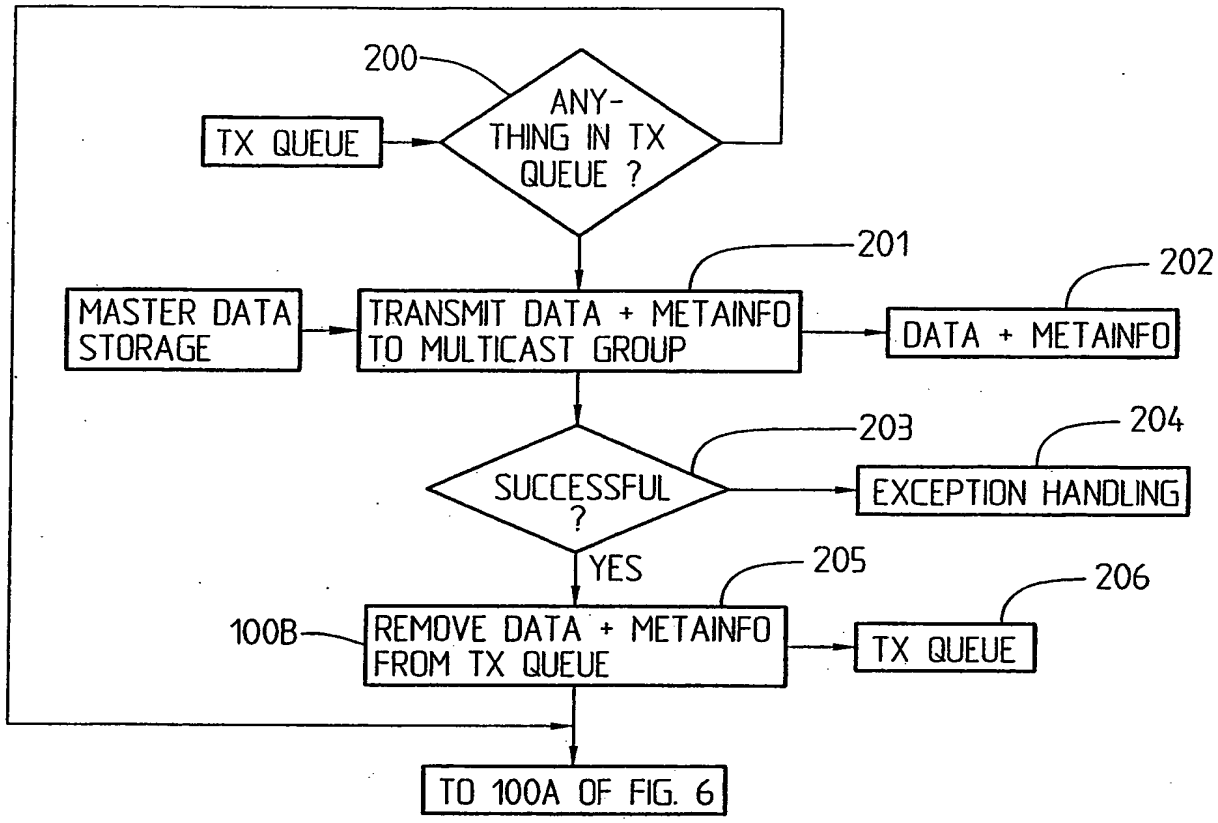
200
ANY-THING IN TX QUEUE ?
TX QUEUE
201
202
MASTER DATA STORAGE
TRANSMIT DATA + METAINFO TO MULTICAST GROUP
DATA + METAINFO
203
204
SUCCESSFUL ?
EXCEPTION HANDLING
YES
205
206
100B
REMOVE DATA + METAINFO FROM TX QUEUE
TX QUEUE
TO 100A OF FIG. 6

Fig. 7

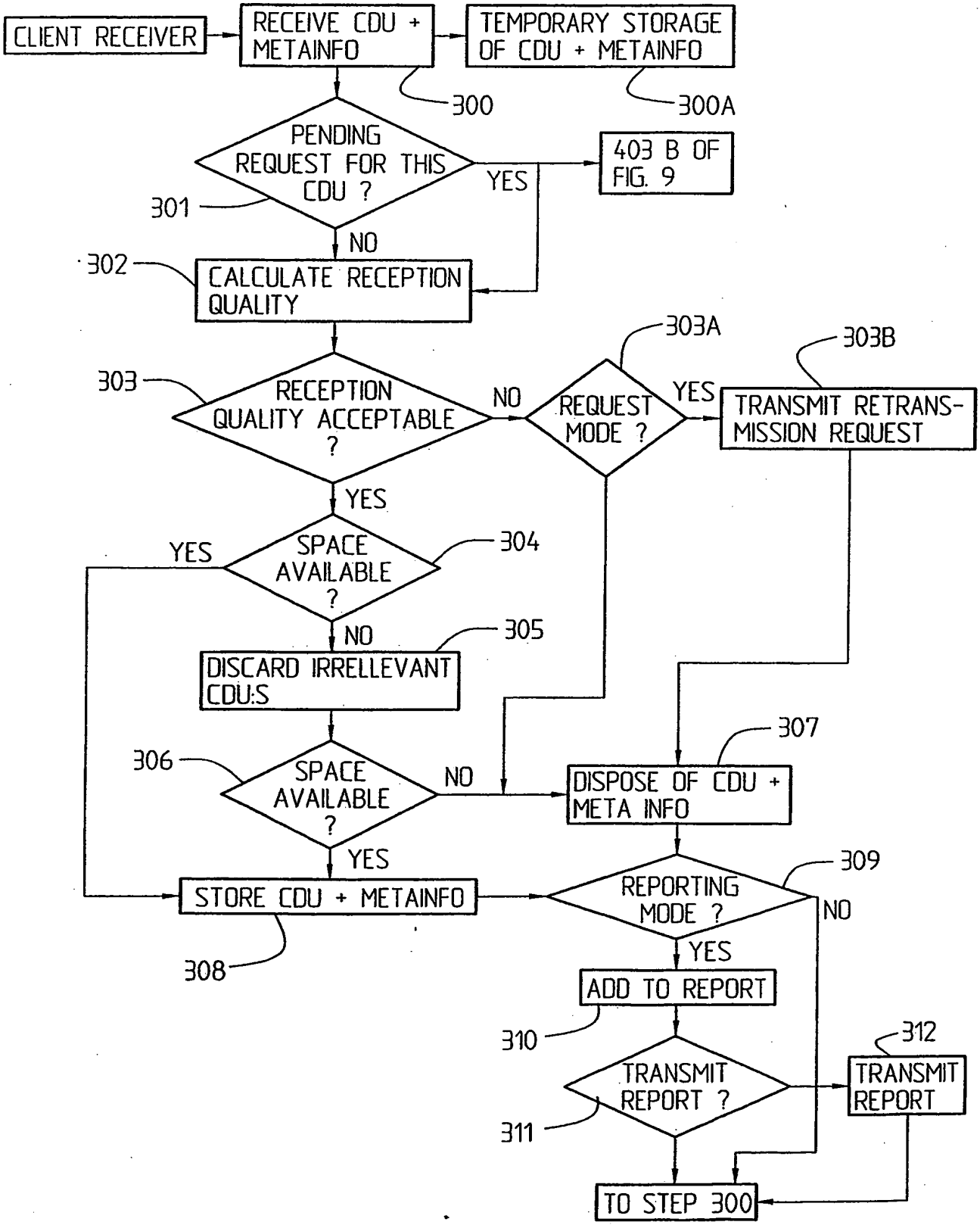
CLIENT RECEIVER
RECEIVE CDU + METAINFO
TEMPORARY STORAGE OF CDU + METAINFO
300
300A
PENDING REQUEST FOR THIS CDU ?
YES
403 B OF FIG. 9
301
NO
302
CALCULATE RECEPTION QUALITY
303A
303B
303
RECEPTION QUALITY ACCEPTABLE ?
NO
REQUEST MODE ?
YES
TRANSMIT RETRANS-MISSION REQUEST
YES
YES
SPACE AVAILABLE ?
304
NO
305
DISCARD IRRELLEVANT CDU:S
307
306
SPACE AVAILABLE ?
NO
DISPOSE OF CDU + META INFO
YES
309
STORE CDU + METAINFO
REPORTING MODE ?
NO
308
YES
ADD TO REPORT
310
312
TRANSMIT REPORT ?
TRANSMIT REPORT
311
TO STEP 300

Fig.8

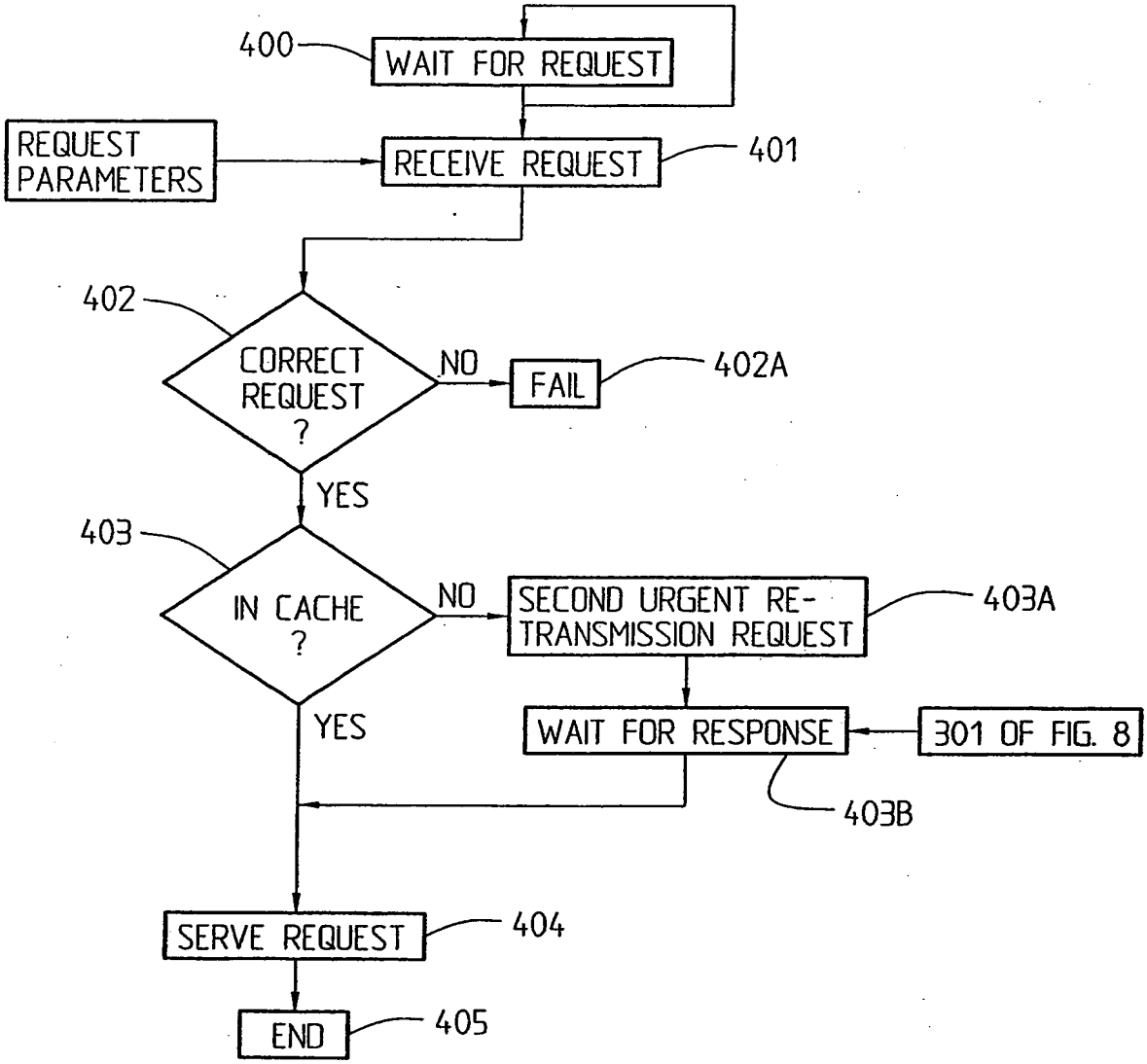
400
WAIT FOR REQUEST
REQUEST PARAMETERS
RECEIVE REQUEST
401
402
CORRECT REQUEST ?
NO
FAIL
402A
YES
403
IN CACHE ?
NO
SECOND URGENT RE-TRANSMISSION REQUEST
403A
YES
WAIT FOR RESPONSE
301 OF FIG. 8
403B
SERVE REQUEST
404
END
405

Fig. 9

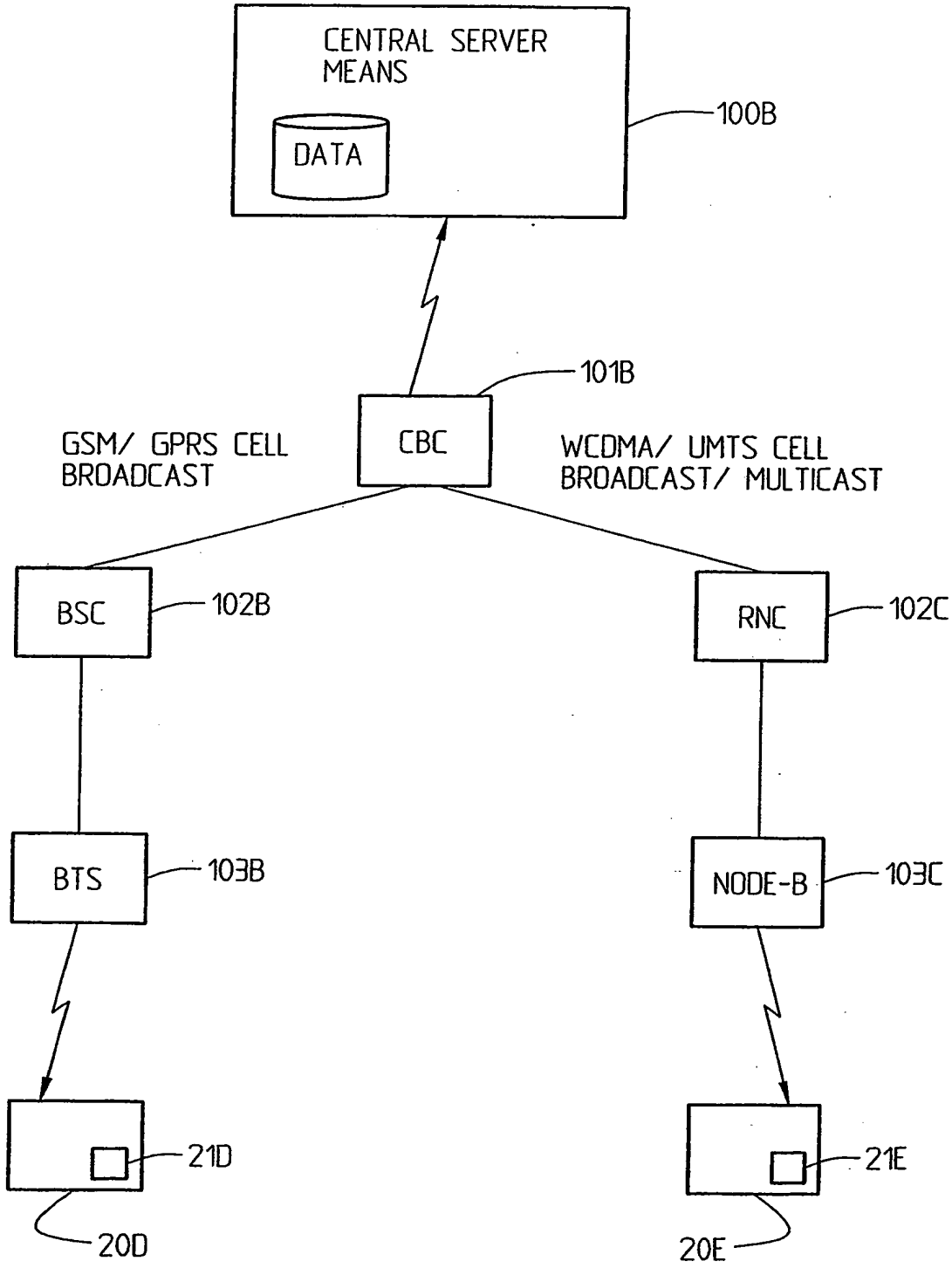
CENTRAL SERVER MEANS
DATA
100B
101B
CBC
GSM/ GPRS CELL BROADCAST
WCDMA/ UMTS CELL BROADCAST/ MULTICAST
BSC
102B
RNC
102C
BTS
103B
NODE-B
103C
21D
20D
21E
20E

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 03/00177

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G06F 17/30, G06F 13/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G06F, H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0853287 A2 (NOKIA MOBILE PHONES LTD), 15 July 1998 (15.07.98), page 3, line 20 - line 26, abstract ---	1-30
A	WO 0044169 A1 (PIXELWORLD NETWORK, INC), 27 July 2000 (27.07.00), page 1, line 9 - line 11; page 8, line 1 - line 3, abstract ---	1-30
A	US 6338094 B1 (SCOTT, S.T ET AL), 8 January 2002 (08.01.02), abstract ---	1-30

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed
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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 May 2003	16 -05- 2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Alexander Lakic /LR Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 03/00177

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	US 6349339 B1 (WILLIAMS, H.R.), 19 February 2002 (19.02.02), page 1, line 44 - line 55; page 2, line 59 - line 65, abstract --	1-30
P,A	WO 0249343 A1 (BRITISH TELECOMMUNICATIONS PLC), 20 June 2002 (20.06.02), page 1, line 12 - line 19, abstract -- --------	1-30

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 03/00177

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		FI 965278 A	01/07/98
		JP 10257100 A	25/09/98
		US 6154745 A	28/11/00
WO 0044169 A1	27/07/00	AU 2735300 A	07/08/00
US 6338094 B1	08/01/02	US 6317791 B	13/11/01
		US 2001044832 A	22/11/01
		US 6317780 B	13/11/01
		US 2001044846 A	22/11/01
US 6349339 B1	19/02/02	US 6108686 A	22/08/00
WO 0249343 A1	20/06/02	AU 2092702 A	24/06/02
		AU 2382902 A	24/06/02
		GB 0030706 D	00/00/00
		WO 0249342 A	20/06/02
		GB 0108094 D	00/00/00